DO YOU DEVELOP PHOTOGRAPHS?

Would you like to:

- **Improve your profits?**
- **Avoid regulatory headaches?**
- **Do your part in protecting the environment?**

If you answered yes to any of these questions, read this Code.
It is one of your finest resources!

PHOTOPROCESSING
CODE OF PRACTICE

INTRODUCTION & CHECKLISTS

Best Management Practices For Pollution Prevention and
Pollution Prevention Award Certification

by:
The Joint Task Force of the City of Albuquerque
Public Works Department/Pollution Prevention Program
and the New Mexico Silver Users Association

1998

Reference Materials Request

If you would like to receive reference materials mentioned in this Checklist please fill out and mail the attached postcard or call the Pollution Prevention Program at (505)873-7059, 873-7058 or 873-7004, or fax at 873-7087

There is no charge for the Reference Manual.

If the postcard is missing you may call the above phone numbers or write to:

City of Albuquerque
PWD/WWUD - Pollution Prevention Program
4201 Second St. SW
Albuquerque, NM 87105

Table of Contents

Appendices E through H are contained in the Reference Materials document. These materials are available on request.

Acknowledgments

This document has been completed with the assistance of the New Mexico Silver Users Association (NMSUA), a non-profit trade association working to educate industry and the public on business and environmental issues.

Cover stock is 100% tree-free, chlorine-free, acid-free Kenaf paper made by Vision Paper, based in Albuquerque, NM. Kenaf is an herbaceous annual related to cotton and okra, and is a member of the mallow family indigenous to West Africa. It grows quickly and is an environmentally sustainable and socially responsible alternative to the use of trees as a paper source. Kenaf can be pulped more cheaply and cleanly than virgin wood using commercially available technologies and existing pulping processes. The widespread use of Kenaf has potential to revitalize agricultural communities, take the pressure off old growth forests, and prevent the release of toxic emissions into the environment.

Cover design and the Photoprocessing Code of Practice project was designed, coordinated and written by Daniel Gates of the City of Albuquerque=s Pollution Prevention Program. Photographs were digitally imaged from slides using a Microtek 1850 Slide Scanner on loan by David Callahan of the Sierra Architects.

Disclaimer:

The City of Albuquerque does not endorse any of the techniques, businesses, equipment, or methods mentioned in the following document. This document is intended only as advisory guidance for the Photoprocessing industry in developing approaches for pollution prevention/source reduction. Compliance with environmental and occupational safety and health laws is the responsibility of each individual business and is not the focus of this document.

Introduction

This Code of Practice is intended to promote a baseline of voluntary compliance practices by businesses. Businesses participating will be certified by the City and awarded annual recognition certificates, which will be published in local media. The Code identifies options and alternatives to achieve pollution prevention goals according to the processes used in photoprocessing.

The Pollution Prevention Program is non-regulatory and is an educational and research tool that can provide you with information concerning methods of source reduction and pollution prevention for your business. If requested, Pollution Prevention personnel are available for on-site consultations to review your photoprocessing processes and discuss methods of pollution prevention and waste minimization as needed. The Program can also put you in contact with other non-regulatory services concerning hazardous waste, air quality and storm water, if requested.

The New Mexico Silver Users Association (see appendix A) worked with the Albuquerque Public Works Department/Pollution Prevention Program staff to identify opportunities to reduce all types of discharges from photoprocessing facilities. Of particular interest is the reduction of silver and other heavy metal discharges.

The City of Albuquerque is also part of the National Environmental Advisory Task Force (NEAT), which is a national group of trade associations, technical societies, municipalities, and government agencies whose members are vitally affected by the environmental regulation of silver. The NEAT's purpose is to encourage communications between the regulatory and regulated communities, support scientific research, and share current scientific, technical and economic information so that the common goals of pollution prevention, recycling, water conservation, and regulatory compliance can be met.

❑ Understanding the Code of Practice for Photoprocessors

The enclosed material is the Photoprocessing Code of Practice Introduction & Checklists. A companion document, the Reference Materials, is available on request. The Code of Practice is not a regulatory document. Methods and processes mentioned herein are not required, but are included as examples of methods of pollution prevention common to the industry. The Checklists refer to page numbers in this document and the Reference Materials document where specific information can be found. If you find that the information you are seeking is not in the Code, please contact the Pollution Prevention Program at (505)873-7059 to either request additional information, or to provide information on pollution prevention or waste management practices common to other businesses with similar processes and equipment.

A great amount of information is provided in this Code including references to hazardous waste issues. The hazardous waste issues are meant to inform you as to the potential liabilities your business could possibly face. Much of the information provided is an attempt to prevent your company from the need of dealing with hazardous waste regulations by removing your wastes from the classification of being a hazardous waste, or reducing the amount of wastes your company generates. Your knowledge of hazardous waste issues is your best chance to avoid potential liabilities and to reduce or remove your wastes from the hazardous waste classification. (see Appendix F. Hazardous Waste Information).

This segment of the Code includes:

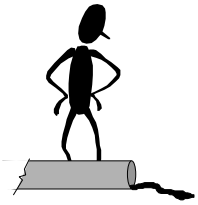
1. Introduction
2. Section 1: Pollution Prevention Checklists
3. Section 2: The Photographic Process, Photoprocessing Materials which are of Concern, and Estimating Silver Concentration in Fixer Solutions
4. Section 3: Photoprocessing Checklists
5. Appendices: A, B, C, D, and Bibliography

❑ What the Code Will Not Answer

This Code will not answer specific questions concerning health and safety. Due to the variety and number of chemicals and processes used in photoprocessing, the Code would be unable to maintain a focus on pollution prevention while attempting to address all health and safety issues. If you are concerned about facility health and safety, you should consult OSHA or the PMA (See Appendix B).

see Appendices in the Reference Materials document. If you do not have the Reference Materials contact the Pollution Prevention Program for the Reference Materials or for the following appendices: Appendix G. Indoor Air Quality.

❑ The Need for the Code of Practice



Wastewater discharged from photoprocessing facilities to Publicly Owned Treatment Works (POTWs), is of interest to many municipal, state and federal agencies. POTWs must oversee the discharges and require the removal of metals such as silver and copper, as well as other chemicals, to maintain compliance with their EPA permit discharge requirements. Although significant loading can come from other industrial sources, the large number of photoprocessing facilities in Albuquerque is of special interest to the Albuquerque POTW. A recent survey of the Albuquerque photoprocessing industry identified over 250 photoprocessing businesses.

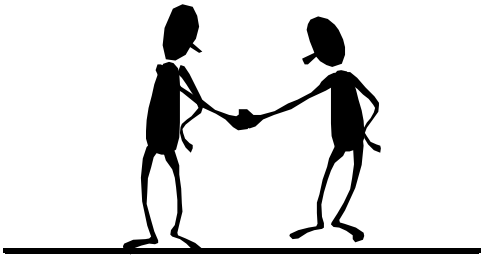
The major areas of opportunity identified by the New Mexico Silver Users Association for reducing metals and chemical discharges from photoprocessing facilities include the following:

Major Areas of Opportunity

1. Better understanding of the technologies and the capabilities of on-site metal recovery equipment and procedures.
2. Written, standardized procedures for operation and maintenance of the processing and metal recovery equipment, and collection and storage of materials for recovery.
3. Better analytical tools for measuring metals concentration.
4. Training programs for operators and maintenance personnel.
5. Improved record keeping. Know what you use and throw away.
6. Equipment and process inspection and spill control plans.
7. Process modifications to minimize metal and chemical discharges.
8. Translation of training materials and procedures into languages other than English.

This Code of Practice identifies Best Management Practices (BMP) for photoprocessors. This Code could be implemented by any POTW to assist businesses and to assure compliance with EPA and State discharge limits. The Code can also be implemented as part of a pretreatment program to include a pollution prevention program component. The guidelines can then be implemented by businesses who will then be certified and given annual recognition certificates under the Program.

Participation is voluntary, but the alternative is to face potentially more direct regulation through permitting, discharge reporting, etc. Avoiding this regulatory alternative is in everyone's interest. The goal of the Code of Practice concept is to achieve results through voluntary compliance which will ensure that the City's wastewater discharge to the Rio Grande is environmentally acceptable.



Avoiding this regulatory alternative is in everyone's interest.

POLLUTION PREVENTION PROGRAM

A non-regulatory, technical assistance program for businesses on the latest waste reduction methods and technologies.

WHAT IS POLLUTION PREVENTION?

Pollution prevention is the use of materials, processes or practices that reduce or eliminate the creation of pollutants at their source. This includes: equipment modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control that results in reduced waste generation. Even though recycling, energy recovery, treatment, and disposal are not included in this definition, some forms of "in-process" recycling may qualify as pollution prevention.

HOW THE POLLUTION PREVENTION PROGRAM WAS CREATED:

In September of 1992, the City of Albuquerque received a 2 year Pilot Program grant from the United States Environmental Protection Agency and the New Mexico Environment Department to initiate a technical assistance Pollution Prevention (P2) Program for industries within the City. The Pilot Program encouraged a permanent program within the Wastewater Utilities Division of the Public Works Department. The goal of the Program is to assist the industrial community in eliminating pollution through the use of source reduction techniques and technologies. If pollution is reduced, industries and the City spend less time and money on waste treatment, disposal and regulatory compliance.

WHAT THE PROGRAM DOES:

The City of Albuquerque owns and operates New Mexico's largest municipal wastewater treatment plant: the Southside Water Reclamation Plant. This facility is capable of receiving and treating 76 million gallons of domestic wastewater on a daily basis. The Plant services more than 400,000 people, 100 permitted industries and over 10,000 commercial accounts. Reduction of wastewater pollutants at their source eliminates the need for treatment and disposal, and results in smoother operations, helping to maintain compliance with the City's discharge to the Rio Grande, and provides a cleaner environment.

THE PROGRAM:

Pollution prevention assistance can range from supplying information on vendors of a particular chemical or piece of equipment, to conducting a detailed on-site waste reduction assessment of an industrial facility. During a waste reduction assessment the pollution prevention team look to source reduction and pollutant elimination as the primary methods of reducing waste generation and the need for waste disposal. Techniques like water recycling can sometimes achieve significant cost savings over a short period of time. In many assessments it is determined that hazardous materials can often be replaced by less or non-hazardous substitutes.

THE POLLUTION PREVENTION STAFF:

The Pollution Prevention Program staff consists of one environmental engineer, two full-time waste minimization specialists and one intern all with experience in industrial processes and waste reduction methods. Pollution Prevention Program staff are available to assist industries in implementing pollution prevention activities within their facilities.

OPPORTUNITIES TO SAVE MONEY:

Since the Program's inception in September of 1992, the Pollution Prevention Program has assisted more than 100 businesses in understanding and making use of the latest developments in pollution prevention and waste reduction. These businesses have saved money by eliminating costly waste treatment and disposal problems and stringent regulatory requirements associated with waste management.

VOLUNTARY COMPLIANCE GOAL:

Participants are encouraged to consider the Best Management Practices mentioned in Codes of Practice as developed for different types of businesses. Codes of Practice will be developed with the help of businesses and be in line with national and local regulations and guidances where available. This is intended to be a voluntary compliance program insofar as legally permissible. Formal wastewater discharge regulation through discharge permits issued by City's Wastewater Pretreatment Unit will be needed only where legally required or for those parameters found to be in violation of the City's discharge to the Rio Grande.

RECOGNITION AWARDS:

The Pollution Prevention Program has recognized more than 100 industries for their commitment to reduce silver discharges. These businesses were awarded with the 5PPM Silver Program certificate. A Pollution Prevention certificate is being developed to recognize business' which have implemented facility wide pollution prevention plans.

5 PPM SILVER PROGRAM

A non-regulatory recognition program awarding businesses for their efforts to voluntarily meet the City's 5 parts per million discharge requirement

GOAL: To reduce facility total silver discharge to 5 parts per million (mg/L) or lower

The 5 PPM Silver Program is a joint effort of the City of Albuquerque and the New Mexico Silver Users Association (NMSUA). The program relies on voluntary compliance to reduce the amount of silver being discharged into the City's sewer system.

How the Program Functions:

1. The City of Albuquerque's Waste Minimization Program and NMSUA will provide information and assistance on how to reduce silver discharges.

2. To be considered for the program:

   A. The facility (e.g. jewelers, photoprocessors, printers, etc.) must, in some manner, utilize silver that results in a potential waste.

   B. The facility should have or be prepared to implement and maintain an appropriate silver reduction plan necessary to maintain a silver discharge at or below 5 ppm.

   C. Records must be kept showing that the silver recovery/reduction equipment/program is being maintained properly and that the recovered/spent material is being reclaimed or disposed of properly.

The facility should obtain and file the manifests or receipts and EPA ID numbers (where necessary) of the reclaimer, recycler or disposal service.

   D. Businesses must fill out the 5 PPM Silver Program Application (one page)

   E. Site visits will be conducted by the City to determine facility compliance. Sampling will determine silver discharge levels.

3. Those facilities meeting the above criteria and complying with the 5 ppm discharge requirement will receive a certificate of recognition. Any facility not maintaining the 5 ppm standard will loose this certificate, but the City will work with the business to find an appropriate method to reduce silver discharge.

All facilities participating in the program will be sampled annually and recertified. The Program has over 70 participants and is growing. Many businesses advertise their commitment to Pollution Prevention in their Yellow Pages and other advertisements.

The New Mexico Silver Users Association encourages public patronage of 5 PPM Silver Program members.

Businesses can apply through the NMSUA by writing to:
NMSUA, PO. Box 25801, Albuquerque, NM 87125-0801, or contact the Waste Minimization Program at (505)873-7004 for additional information.

Or you can fill out and mail the following, attached application.

PHOTOPROCESSORS
5 PPM SILVER PROGRAM APPLICATION

Jointly sponsored by New Mexico Silver Users Association
and the
City of Albuquerque -Public Works Department/Wastewater Utility Division
Pollution Prevention Program

Business Name:_____

Business Address:_____

City: _____ **State:** _____ **Zip:**_____

Telephone: _____ **Fax:**_____

How many years at present location:_____

Business Contact:_____

Title: _____ **Phone:**_____

Business Type: (check all that apply)	Commercial Printing	Printing
	Graphic Arts	Professional Photo Studio
	Medical Practice	Dental Practice
	Commercial/Photo Lab	Other _____
Processing Type: (Check all that apply)	Color Film &/or Paper	Medical X-Ray
	Dental X-Ray	B&W Film &/or Paper
	Movie Film	Non-Destructive Testing X-Ray
	Slide Film	Research Radiography
	Microfilm	Other _____

WASTE MINIMIZATION PRACTICES

1. Does your business use any of the following silver recovery equipment (i.e. metallic replacement cartridge(s), electrolytic unit(s), or other methods)? If so please list:

_____

_____

2. If your business does not use any silver recovery equipment, is any silver bearing waste delivered or picked up for silver recovery? Please list who accepts the silver bearing waste and what is done with the waste:

_____

_____

3. Please estimate how much fix/bleach fix your business uses monthly or annually (on average), which months are your peak production month(s):

_____

_____

AGREEMENT
I understand that membership in the 5PPM Silver Program requires this business to adhere to the following code of practice:

A. The business should have or be prepared to install and maintain appropriate equipment in order to maintain a silver discharge under 5PPM.

B. Records should be kept showing that silver recovery equipment is being maintained properly and that materials are being reclaimed or disposed of properly.

C. Businesses that do not use any silver recovery equipment should keep records of where material is sent for reclamation or disposal.

D. Inspections will be conducted by the City to determine facility performance. Free wastewater samples may be taken on an annual basis to determine silver discharge levels.

I believe that the information herein is true, accurate, and complete.

_____	_____
Print Name	Title
_____	_____
Signature	Date

Mail this plan to:

Waste Minimization Program
5 PPM Silver Program
COA - PWD/WWUD - Pretreatment Unit
4201 Second ST SW
Albuquerque, NM 87105
(505)873-7004

❑ The Photoprocessing Industry

The New Mexico photoprocessing industry represents a $10 million wage industry, with over $43 million in receipts. Most, if not all, of these businesses are small with fewer than 50 employees. Many small businesses are trying to implement their own solutions to pollution problems but lack the resources to identify and implement changes. Due to increased regulation and stiffer competition simple solutions to environmental compliance and innovative processes need to be identified to help this industry maintain a viable and competitive advantage.

A survey conducted by the City of Albuquerque Public Works/Pollution Prevention Program identified more than 250 businesses within metropolitan Albuquerque involved in the photographic industry. The primary businesses identified are commercial photography, photographic studios, and photofinishing labs.

Large photoprocessing facilities include some of the larger photofinishing labs. These large facilities may use more than 25,000 gallons per day (GPD) of process water and/or process more than 40 gallons of silver rich waste fix/bleach fix per month.

Small and medium photoprocessing facilities represent more than 75 percent of the total number of Albuquerque's photoprocessing facilities. These facilities include the one and two person custom commercial photoprocessors and portrait studios. Medium sized facilities typically process 20 to 40 gallons of silver rich waste fix/bleach fix per month. Small facilities typically process less than 20 gallons of silver rich waste fix/bleach fix per month. Most of these facilities typically practice some type of silver recovery. However, the efficiency of the recovery systems is often not optimal or fully understood and maintained.

Section 1:
Pollution Prevention Checklists

Photoprocessors can potentially generate a variety of byproducts and recoverable materials in their operations. Some common types may include:

- Spent developers
- Acid and alkaline cleaning solutions
- Recoverable heavy metal solid wastes
- Chlorofluorocarbons (CFCs)
- Spills and leaks
- Liquids containing recoverable heavy metals
- Spent fixers, includingbleach fix
- Concentrated rinsewaters
- Chlorinated solvents
- Waste Film
- Obsolete/outdated stock

❑ Introduction to Pollution Prevention

Although it has become a catch phrase, pollution prevention is an integral facility process. Many photoprocessors have been practicing pollution prevention for years. Good housekeeping and inventory management, production optimization, recycling, recovery and reuse are all methods of pollution prevention. What pollution prevention does is take these ideas and place them under a single heading, but this does not diminish the practices already in use by many photoprocessing facilities.

Pollution prevention involves questioning and reviewing every facility process, the chemicals and the associated procedures. The ultimate questions that should be asked are: ***'Am I doing this process this way simply because I've always done it this way?'*** and; ***'Is there a better, less polluting and potentially less expensive, way of doing this process?'*** The answers will often be yes.

Pollution prevention consists of waste management approaches that reduce the amount of waste materials generated or requiring disposal. Pollution prevention can reduce the amount of hazardous and non-hazardous wastes generated in your business.

This benefits businesses by minimizing:

- disposal costs
- off-site treatment costs
- insurance costs
- regulatory compliance costs (record keeping, reporting, tracking, lab costs, etc.)
- cost of future liabilities
- worker safety costs
- current operating costs (e.g., raw material costs)
- transportation costs
- fees and taxes

Additionally, pollution prevention can increase business productivity and employee safety, improve environmental protection, and enhance community relations. These benefits may be realized by a business by implementing the following pollution prevention methods:

Source Reduction: is an activity that prevents or reduces the generation of waste materials that may otherwise be released to air, land or water. Examples include: substituting input material or changing production processes to reduce the amount of waste generated. A good example is substitution a solvent with a water based cleaner. This not only reduces the VOC content in the facility but also increases employee safety and can often reduce material cost.

Recycling: is the use, reuse, or reclamation of materials. Examples include: employing on-site or off-site techniques to remove contaminants from a waste stream so that the regenerated material can be reused. A good example is silver recovery from spent fixers. Silver recovery is a common practice in photoprocessing and instead of disposing of discharging the spent fixers, which removes the silver from future use, the silver can be recovered, reclaimed and reused.

Silver scrap and flake recovered from electrolytic units and all recovery cartridges should be triple rinsed to remove any residual fixer (first rinse should go bach into the holding tank). This is the industry standard procedure and will reduce the possibility of the material being considered a hazardous waste. Fixers are considered hazardous when they contain more than 5 mg/L (ppm) of silver, but triple rinsed silver scrap and cartridges are not considered hazardous when sent to a recycler. (See Reference Materials, Appendix E. PMA Information)

To be successful, a pollution prevention program must be organized. It is not hard to organize a pollution prevention program, but you will need to spend some time to get started. While conducting your self-assessment keep in mind the following principles:

Principles of Pollution Prevention

1. Facility owners/managers must be committed to pollution prevention for it to work.
2. A pollution prevention program should include specific written goals and objectives.
3. Identify your wastes. Are they hazardous or non-hazardous?
4. You should know how your materials and wastes are managed and the associated costs.
5. Train all employees in waste handling and pollution prevention methods.
6. Be aware of the waste regulations that apply to your business.
7. Make pollution prevention an integral part of all facility processes, not just a folder on your desk.

The following chart shows the basic steps you can use in implementing a pollution prevention program in your business.

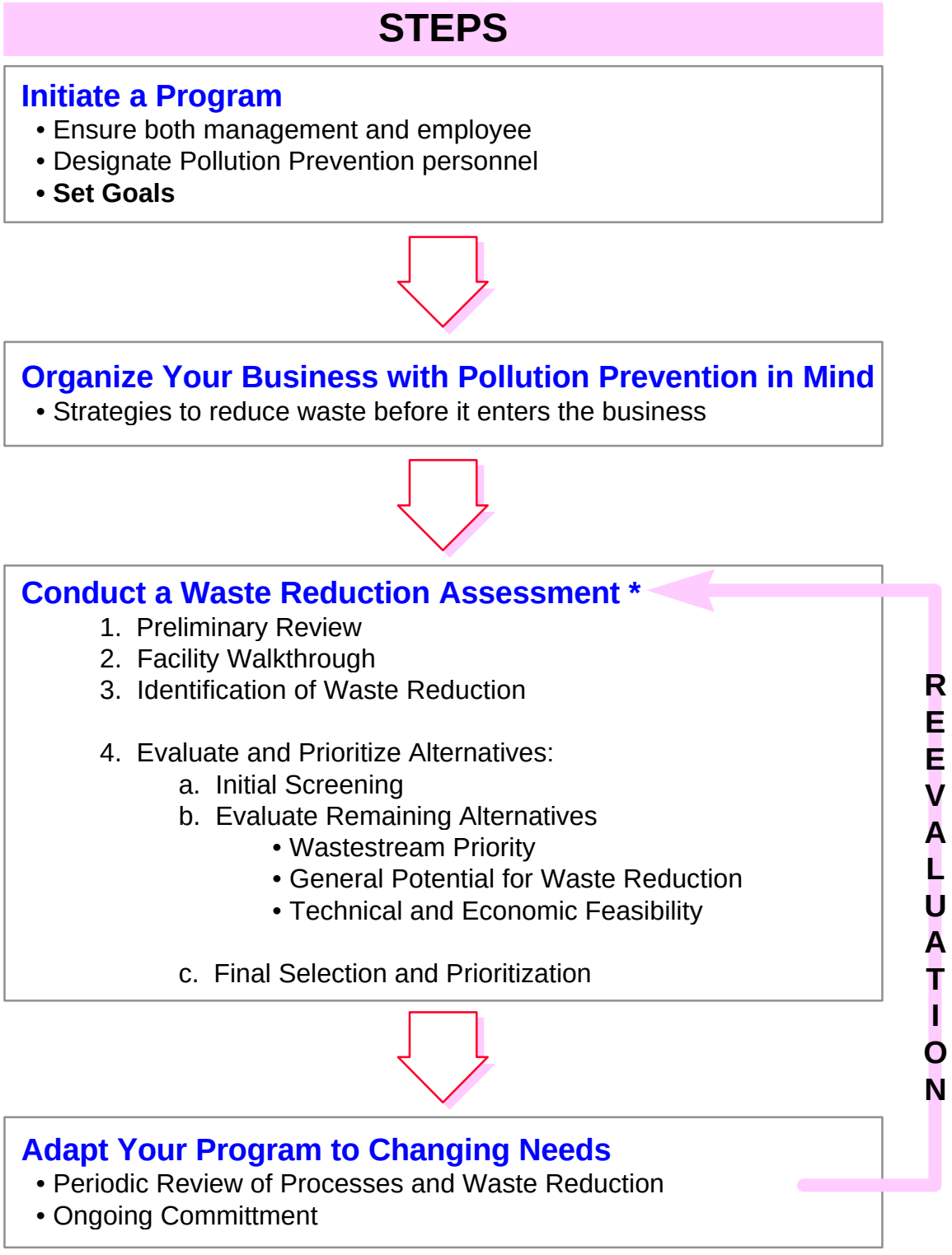


Figure 1. Pollution Prevention Program Steps

❑ Liability

Pollution prevention can be conducted in several areas of a business. These areas pose differing levels of liability. It can be said that the more a business does to reduce the amount of wastes generated the less liability for the business. The more wastes a business sends to disposal the greater the business liability. The different areas are:

1. **Inventory Management** - buy only what you need to reduce out dated stock chemicals. Rotate stock to use chemicals in date sequence. Check delivered stock for damage to reduce spills and to return damaged stock.

2. **Production-Process Modification** - Modify the manufacturing process to reduce waste. Simple quality and process checks can reduce the amount of wastes generated.

3. **In-Process Recovery and Reuse** - Increase the amount of materials recovered and reused within the facility process.

4. **On-Site Recovery and Reuse** - Increase the amount of materials recovered and reused within the facility.

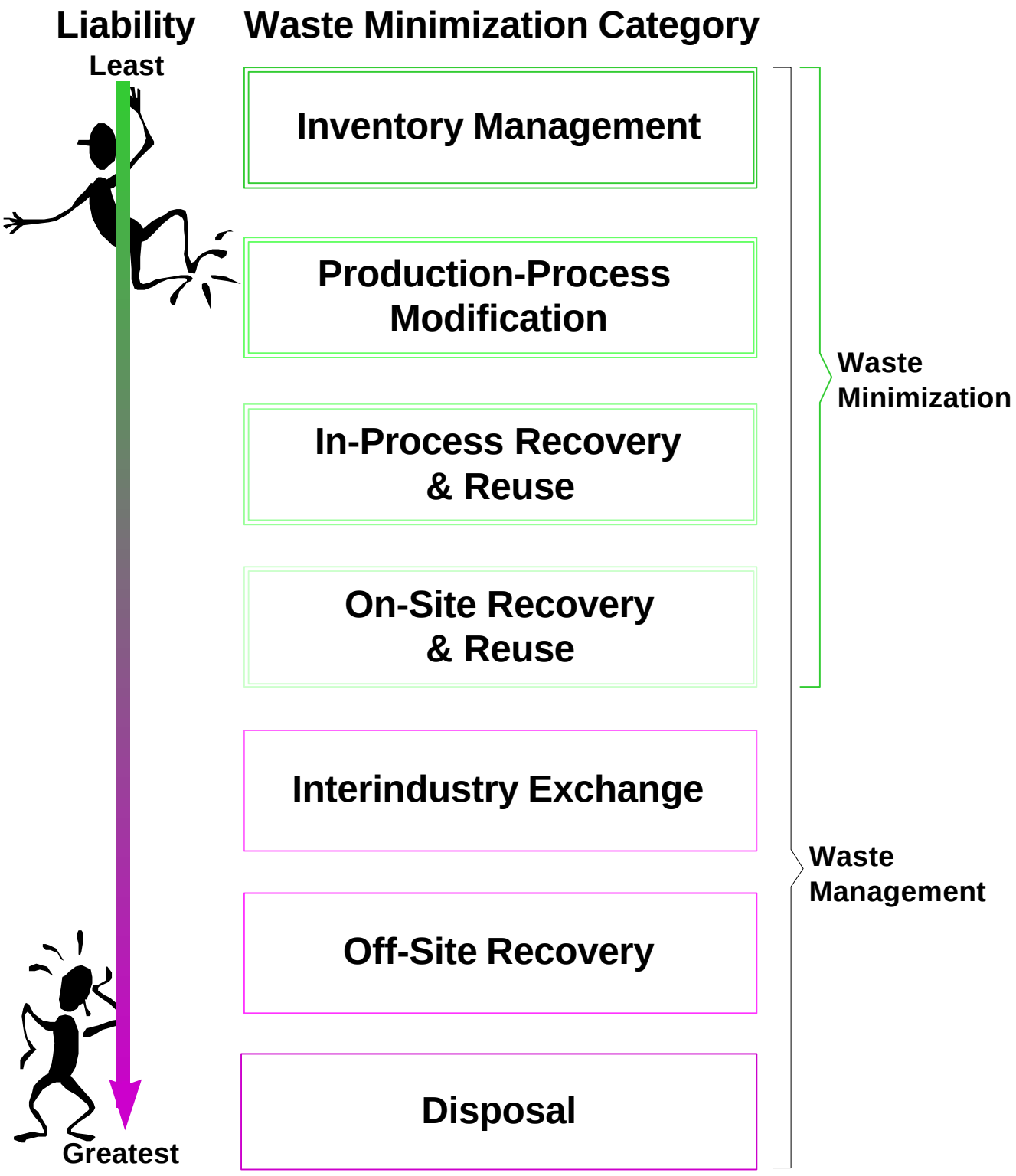
5. **Interindustry Exchange** - Waste materials can be exchanged between businesses. One business' waste material may be another's raw material. Materials traded are usually in very large quantities such as tons or railroad car volumes.

6. **Off-Site Recovery** - Sending materials for off site smelting, refining and recovery, etc.

7. **Disposal -**Sending materials off-site for disposal as hazardous waste. Due to strict regulations hazardous waste disposal carries the greatest level of liability. Disposal is not considered a waste reduction method, but can be an associated process when materials are disposed of properly after waste reduction or recovery techniques have been used.

Treatment is not a method of pollution prevention/waste minimization, but you can treat your hazardous wastes on site if you follow certain regulations. These regulations cover issues of accumulation, storage and labeling requirements, and accident prevention. **See Reference Materials, Appendix F, pages F.13-F.15 Managing Hazardous Waste.**

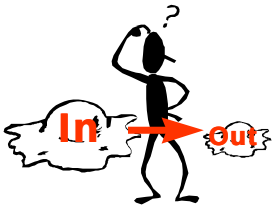
The following chart shows the differing levels of liability by pollution prevention procedure.



(Adapted from 'Standard Handbook of Hazardous Waste Treatment and Disposal', McGraw Hill, Harry Freeman, Editor in Chief, 1989)

Disposal carries the greatest amount of liability.

❑ Assessing Your Pollution Prevention Opportunities



These checklists will help you perform a pollution prevention assessment. The objective of this assessment is to identify ways to reduce or eliminate waste, or recover materials, through a careful review of your facility operations and waste streams. After selecting a specific area, or areas, to focus on in your pollution prevention efforts, a number of options should be developed and evaluated. Then, evaluate the technical and economic feasibility of the selected options. Finally, select the most promising pollution prevention options for implementation.

Useful Questions:

1. What are the recoverable materials and/or hazardous and non-hazardous wastes, and from what processes are the materials/wastes, generated? What are the volumes generated?

1. Which wastes are hazardous and which are not? What makes these wastes hazardous?

Silver scrap and flake recovered from electrolytic units and all recovery cartridges should be triple rinsed to remove any residual fixer (first rinse should go back into the holding tank). This is the industry standard procedure and will reduce the possibility of the material being considered a hazardous waste. Fixers are considered hazardous when they contain more than 5 mg/L (ppm) of silver, but triple rinsed silver scrap and cartridges are not considered hazardous when sent to a recycler.

3. What are the input and the processed materials used which generate the wastes of a particular process?
4. How much of a particular input material is used in the process?
5. What are the raw material process losses?
6. How efficient is the process?
7. Are unnecessary wastes generated by mixing recyclable wastes with other process wastes, especially with hazardous wastes?
8. What housekeeping practices are used to reduce the amount of waste generated?
9. What process controls are used to improve process efficiency?
10. What are the facility's current hazardous and non-hazardous waste disposal costs (including disposal fees, permit fees, raw material purchases, etc.)
11. **Are you mixing hazardous wastes with non-hazardous wastes?** This is extremely important. If you mix hazardous wastes with non-hazardous wastes you are increasing the amount of hazardous waste you paying to have disposed. You should be segregating your hazardous and non-hazardous wastes to reduce you disposal costs. This means that you should also be familiar with you wastes and understand what constitutes a hazardous waste.

See Appendix E. PMA Information, and Appendix F. Hazardous Waste Information, for additional Information.

❑ Checklists

Complete the following pollution prevention checklists to see if your business is maximizing pollution prevention techniques.

❑ Management Practices

1. Does your facility have an established pollution prevention program in place? **Yes** **No** **Is a specific person or committee assigned to oversee the success of the program?** **Yes** **No** **Does the program have set pollution prevention goals?** **Yes** **No**	If there is enough staff available, a committee may be more successful than a single person. One person is not always available when necessary, could leave the company or otherwise be absent, and may not have the expertise in all necessary areas. Pollution prevention programs are more successful if they contain written pollution prevention elements, especially when setting goals.
2. How frequently are overall material balances for the facility performed?	In order to accurately assess your pollution prevention efforts, you must keep track of the raw materials entering and the products and wastes leaving your processes.
3. Are there employee education programs on how to avoid excessive waste generation? **Yes** **No** **How often are the training programs offered?**	You can reduce the amount of waste generated by spills if you train employees to properly handle and store hazardous and other wastes. Some trade associations and local environmental health agencies sponsor employee training seminars and some consulting firms offer employee training as part of their package of services. 
4. Are you fully aware of the current local, state, and federal regulations related to hazardous material storage, treatment, disposal, and recycling? **Yes** **No**	Compliance with existing laws and regulations is helpful to a good pollution prevention program. See Reference Manual, Appendix E. PMA Information and Appendix F. Hazardous Waste Information when reviewing waste generation.
5. Has your facility conducted an environmental assessment to determine regulatory compliance? **Yes** **No**	Assistance is available for any concern. See City and State references in Appendix B, or call the City of Albuquerque's Pollution Prevention Program at 873-7004.

❑ Production Management

Production management involves proper scheduling to reduce the need for equipment cleaning, and dealing with management practices, such as employer/employee relationships, that may have an influence on the amount of waste generated.

1. Are sequential operations adjacent to each other? **Yes** **No**	Sequential operations should be adjacent to avoid excess material handling. This reduces the potential for material and precious metal losses and reduces accidental spills.
2. Are process solutions prepared by trained personnel? **Yes** **No**	You can often minimize waste and improve the consistency of process solutions by assigning a limited number of properly trained personnel to mix chemicals.
3. Does your facility maintain dust collectors and fans in proper working condition? **Yes** **No**	Dust collectors and ventilation fans should be maintained in top working condition. Good maintenance practices will reduce health risks and allow better collection of airborne particles.
4. Does your facility have a formal facility inspection plan? **Yes** **No**	Regular inspections of your facility's storage, waste treatment, and production areas will help maintain optimal production and identify equipment and process malfunctions early. This will help you identify equipment and process problems early and provide time to correct problems before a small problem becomes a major issue.

❑ Spill Control

Spill control is especially important for photoprocessors because of the value of the silver used and the concentration of silver in their process solutions.

1. Does your facility conduct equipment inspections on a routine basis to identify leaks or equipment malfunctions? **Yes** **No**	Routine inspections of your shop's production, storage, and waste treatment areas should be conducted on a daily basis to identify leaks and malfunctioning equipment. Identifying problems at an early stage helps reduce spills and other uncontrolled releases.
2. Do you have procedures in place to handle leaks or spills? **Yes** **No**	Fire departments require spill containment, and material segregation of reactive materials, around storage areas to minimize the spread of any spilled material. Ensuring a quick and proper response to leaks and spills can help you reduce waste generated by the cleanup of spills. Keep an emergency spill plan available and educate employees in its use. Training your employees also satisfies legal requirements. See Reference Manual, Appendix H. Hazardous Materials Emergency Response Plan.

Guidelines for a Spill Control Plan

It is a good idea for any business handling materials which are or may be considered hazardous to have a spill control plan. If a business is unable to contain a spill and it is discharged into the sanitary sewer or storm drain, released into the air, or spilled on the ground it is very important to notify the proper authorities. By preparing and filing your Spill Prevention Plan (with the Fire Department, see Appendix H) you will be fulfilling part of the requirements under RCRA (Resource Recovery and Conservation Act) Hazardous Waste Reporting (see Appendix F, page 21) and under the Superfund Amendments and Reauthorization Act (SARA) community right to know. Following are some general spill control procedures:

1. **Isolate the spill area and limit entry**
2. **Notify the proper authorities:**
   During the work week (Mon-Fri, 8AM to 5PM) call the Industrial Waste Engineer at 873-7004. On weekends, holidays, and after hours telephone notification can be made at 873-6217
3. **Equip trained personnel with PROPER personal protective equipment**
4. **Identify the material and quantity spilled and select an appropriate approach (see MSDS or 1994 Emergency Response Guidebook for guidance).**
5. **If the spill is treated on site, dispose of the spill in accordance with federal, state, and local regulations.**

Accidental spills happen fast and without warning so it is also important to have spill control equipment available. Businesses have to determine what spill control method is best for them. Following are some methods/treatments a business can use for spill control including sorbents, treatment agents, or hazardous material vacuums for spills.

Sorbents. Are materials that soak up liquids through absorption or adsorption. Sorbents come in particulate, sock, or pillow form. Depending on the spilled material the sorbents may be considered hazardous after the spill has been cleaned up.

Treatment Agents. Are usually available for acid, caustic, or solvent spills. They come in dry powder form and are shaken, poured, or sprayed onto a spill. When used properly these agents will neutralize and solidify spills.

Hazardous Material Vacuums. Vacuums can be used to clean up dry chemical spills or to collect and contain virtually any dry pollutants.

Example:

Mr. Spillalot was thinking about the double decker chocolate cake he had waiting for him at home as he pushed a 55 gallon drum of nitric acid around the shop he worked in, Axidentsrus Inc. Suddenly Mr. Spillalot tripped! The acid spilled, and slowly began creeping towards a drain in the floor.

Fortunately Mr. Spillalot's boss a had written spill control plan. Mr. Spillalot remembered his training and looking around he spotted hanging on the wall a piece of paper that said Spill Control Plan.

'Boy, thought Mr. Spillalot, I am sure glad my boss is efficient!!!' After he finished

following the instructions on the paper, and properly containing and cleaning up the spill, he began thinking about the macaroni casserole his wife was making him for dinner.

(see Appendix F. Hazardous Waste Information, Preparing for and Preventing Accidents).

Spill Control Plan

Equipment Required

- ❑ Gloves
- ❑ Apron
- ❑ Goggles
- ❑ Bucket
- ❑ Mop
- ❑ Sponges
- ❑ Absorbent Material
- ❑ Neutralizing Material

Spill Response Procedures

1. Put on Gloves, Goggles and an Apron
2. Contain the spill with a mop or absorbent materials available. Do not allow material to reach floor drains.
3. Check the appropriate material safety data sheet (MSDS) for special handling, ventilation, personal protection, or other pertinent data.
4. Clean up the spill as directed
5. Use the mop and sponge to clean the area thoroughly.
6. Package and label all contaminated absorbent materials for off-site disposal.
7. Notify the manager/owner that a spill has occured (see below).
8. Notify the appropriate government agency (see below).

Spill Response Personnel

Mr. Doright, Manager	555-5765/555-5655
name	pager/phone
Mr. Knowenough, Owner	555-5235/555-5755
name	pager/phone
Ms. Authorizer, City Waste	555-5895
name	pager/phone

Section 2:
Photoprocessing Information

Section 2: Table of Contents **Page**

The Photographic Process

Silver-based photographic materials consist of solid crystals of silver chloride or silver bromide suspended in gelatin and coated on a film or paper support. The processing of photographic films and papers consists of three steps:

1. development of the image;
2. removal of some or all of the silver; and,
3. stabilizing the image by rinsing residual thiosulfate and silver-thiosulfate complexes out of the emulsion layers with water. In the case of washless processing, a stabilizer solution replaces the water.

Black and White Film Processing

Black-and-white photographic materials include X-ray films, graphic arts films and papers, and microfilms, as well as black-and-white motion picture films and professional films and papers. After processing, the image in these materials is metallic silver. In the non-image areas, the remaining solid silver chloride or silver bromide crystals are removed as a soluble silver-thiosulfate complex in a solution called fix. In black-and-white products, about 40% of the silver will remain in the film or paper as the metallic silver image.

Color Film Processing

Color photographic materials include the majority of amateur and professional films and papers and motion picture films, along with some graphic arts products. During development, metallic silver is coupled to the dye. This metallic silver is then converted to crystals of silver bromide or silver chloride by a solution called a bleach. After the bleach step, the silver chloride or bromide is removed as a soluble thiosulfate complex in a fix solution. In some paper processes, the bleach and fix baths are combined into a single solution called a bleach-fix. In color products, virtually no silver remains in the film or paper after processing.

❑ Silver Recovery

Prior to using a silver recovery method, the combined silver-rich solutions resulting from the development of photographic materials will contain between 2,000 and 8,000 mg/L of silver. This concentration will vary even within the same facility and process. While being considered a precious metal, silver is also a regulated pollutant. The City of Albuquerque requires that wastewater discharge not contain more than 5 mg/L silver and the predominant method of meeting this requirement is to use silver recovery equipment or a reclamation company.

Silver is more easily recovered if the fixer is separate from the bleach. For optimum silver recovery, there should be a wash between the bleach and fixer tanks. In processes where there is a single chemical bleach-fix, the recovery process is more difficult and will require greater scrutiny. In black and white film or paper processors, there is no bleach, and silver is easily recovered from the fixer.

By removing silver rich solutions from your waste stream you:

Reduce your liability in meeting wastewater discharge requirements
Reduce your liability in paying hazardous waste handling costs and meeting hazardous waste requirements (silver bearing wastes are considered hazardous wastes)
Possibly increase your business revenues by returning money to your business

City of Albuquerque studies have found that a consistent discharge of less than 5 mg/L can be achieved at the process discharge point, and can typically be done cost effectively (see this document, Appendix D. Case Studies). While existing City regulations require the facility discharge to meet Sewer Use Ordinance limits, it is feasible that future discharges may be required to meet these limits from the process discharge point (i.e., from where the equipment discharges to the sewer system).

NOTE: Dilution is not a valid method of reducing the silver concentration of your photographic solutions. Dilution only increases the volume of the waste and does nothing to reduce the amount of silver being disposed or discharged.

Equipment operators should have a procedure for reclaiming silver from silver-bearing solutions before chemistry is dumped for any reason (including processor cleaning). Where waste collection containers are used in mini-labs, there should be a procedure for disposal of silver-bearing waste through the silver recovery system.

There are many options in processor design that can facilitate silver recovery. It is vital to consider your options in areas of the country where strict discharge limits for silver must be met. It is a lot easier and less costly to plan ahead, than to find out after installation that your processor will not meet discharge regulations. In New Mexico, feel free to contact the New Mexico Silver Users Association at (505)294-5053 for information, industry contacts and advice.

❑ Photoprocessing Materials which are of Concern

Heavy Metals

Heavy metals include cadmium, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, molybdenum, nickel, silver, and zinc. Many of these heavy metals are regulated due to their potential toxicity (see Reference Materials, Appendix F. Hazardous Waste Information, pg. F.5 to F.6). In addition to silver, some photosensitive materials and cleaners may contain small amounts of certain heavy metals. The following is a description of certain regulated heavy metals and other materials that may be found in photographic materials and/or cleaners:

Silver	Silver compounds are the basic light-sensitive material used in most photographic films and papers. Processing solutions will contain silver because the silver will be dissolved by fix and bleach-fix solutions, or it leaches from the film during processing. No silver is used as a component of the solutions themselves. After silver is removed from the photographic films, the silver is carried out in the fix/bleach-fix solution and in smaller amounts from wash water, usually in the form of a silver thiosulfate complex. Much of the silver in the silver thiosulfate complex can and should be recovered.
Chromium	Some bleaches used in black-and-white reversal processes, and some system cleaners, contain chromium compounds. Hexavalent chromium is harmful and should not be discharged to the sewer system.
Zinc	Zinc is present in the effluent of a few color photographic processes.
Cadmium	Cadmium is present in only a few black-and-white films. Cadmium is potentially toxic and should not be discharged to the sewer system.
Selenium	Selenium based toners should not be discharged to the sewer system. If selenium is at 1 ppm (mg/L) concentration then the material is considered a hazardous waste, must be handled as a hazardous waste, and cannot be discharged to the sewer.
Other Materials	
Cyano Complexes	Unlike free cyanide, ferro- and ferricyanide ions (also known as hexacyanoferrates) have a low level of toxicity. Bleaches that contain hexacyanoferrates are used in only a few photographic processes. Since cyanide is present, although it is complexed, it is important to reduce the use or cyanide concentration of these bleaches. The City's industrial wastewater analysis does not differentiate between complexed cyanide compounds (such as hexacyanoferrates) and free cyanide, but rather combines the two and analyzes for 'total cyanide.' Cyanide compounds should not be discharge to the sewer system.
Hydro-quinone	Hydroquinone is commonly used in photographic developers as a reducing agent for silver. Tests have shown that hydroquinone can be toxic to some organisms at relatively low concentrations. Fortunately, hydroquinone is used in very low concentrations, and small concentrations are readily degraded to innocuous products.
Ammonium	Ammonium fixers are a source of high concentrations of ammonium ions. When discharged to a treatment plant some ammonium will be carried through the plant and will be discharged to the receiving river. In the river the ammonium can be oxidized to nitrates and possibly free ammonia. Due to strict regulations the City's treatment plant must remove nitrates prior to discharging to the river and must regulate industrial discharges of ammonium, ammonia, and nitrates.
Phosphates	Metaphosphates are used as sequestering agents in some processing solutions to

and Nitrates	minimize sludging. A few processing solutions contain trisodium phosphate or other phosphates as buffers. Only a few processing solutions contain nitrates and are often in very small concentrations.
Solvents [See below "Common Solvents and Their Hazards"]	Solvents, including xylene, 1-1-1 trichloroethane, alcohols, acetone, etc. should not be discharged to the sewer system. Many solvents are explosive, can react with other materials in a sewer system, and can damage the biological processes used in waste treatment systems. You should review your solvents and their use. Less/non-hazardous alternatives are typically available and you should consult your supplier for a list of alternative solvents or contact the Pollution Prevention Program to research alternatives. Often, the solution is as simple as replacing alcohol with deionized/demineralized water. Since the DI water does not have salts the water will dry without spotting.

* The previous material detailing photoprocessing materials was adapted from Disposal and Treatment of Photographic Effluent, Publication No. J-55, Eastman Kodak Company, 1989.

❑ Common Solvents and Their Hazards

How to use this chart

The solvents are grouped according to chemical class so that relative toxicity and flammability can be compared within the class. Chemicals in the same class often have similar solvent properties, so that safer substitutes may be found using this chart. The chart is meant as a guide to common solvents and their hazards. For more complete information, other sources should be consulted.

ABBREVIATIONS

abdom	abdominal
ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
asp	aspiration
C	Ceiling, level not to be exceeded
chem	chemical
pneum	pneumonia
CNS	Central Nervous System
derm	dermatitis
diarr	diarrhea
disturb	disturbances
dizz	dizziness
drow	drowsiness
FP	Flash Point in degrees Fahrenheit
GI	gastro-intestinal system
head	headache
ing	ingestion
irr	irritating
mm Hg	millimeters of mercury
musc	muscular system
narc	narcosis
NIOSH	National Institute for Occupational Safety and Health
NIOSH**	NIOSH recommends reducing exposure to lowest feasible concentration
OSHA	Occupational Safety and Health Administration
PEL	OSHA Permissible Exposure Limit
PEL*	PEL listed below in chart
perm	permanent
PNS	peripheral nervous system
ppm	parts per million
REL	NIOSH Recommended Exposure Limit
repro	reproductive system
resp sys	respiratory system
TLV	ACGIH Threshold Limit Value
URT	upper respiratory system
UV	ultraviolet radiation
vis	visual system
vom	vomiting
VP	vapor pressure in mm Hg at 68 F

Solvent Class	TLV PEL ppm	FP /F	VP mm Hg	Organs Affected	Symptoms	Comments
ALCOHOLS						**One of the safer classes**
ethanol (denatured, ethyl or grain alcohol)	1000	55	43	CNS, eye irr, nose, skin, liver, repro	drow, fatigue, headache, irr, tremors; repro	least toxic alcohol; identify denatured
isopropyl alcohol (rubbing alcohol)	400	53	33	eyes, skin, resp	mild eye, nose, throat irr; drow, dizz, head; dry skin	One of the least toxic alcohol
Methanol (wood or methyl alcohol)	200	52	92	eyes, skin, CNS, GI	eye irr; head, drow, nausea, vom; vis disturb; blindness	Use ethanol when possible; absorbed through skin
n-propyl alcohol	200	72	21 (77 F)	skin, eyes, resp, GI	mild eye, nose, throat irr; dry skin; drow, head; ataxia	absorbed through skin
isoamyl alcohol (fusel oil)	100	109	2	eyes, skin, resp	eye, nose, throat irr; narc, head, dizz; short breath; nausea, vom, diarr; skin irr	absorbed through skin
isobutyl alcohol	50	82	9	eyes, skin, resp	eye, throat irr; head, drow; skin irr	absorbed through skin
diacetone alcohol	50	125	1	eyes, skin, resp, liver, kidney, blood	eye, nose, throat irr; corneal damage; narc, head, dizz	Most toxic alcohol
ALIPHATIC HYDROCARBONS						
pentane(s)	600	-57	400 (65 F)	skin, eyes, resp	eye, nose irr, drow; derm; chemical pneumonia (asp)	Extremely flammable, REL 120 ppm
heptane	400	25	40 (72 F)	skin, eyes, resp	head, dizz, nausea; derm; chemical pneumonia (asp)	Substitute for n-hexane, Extremely flammable, REL 85 ppm
petroleum distillates	400*	-40 to	appx.	skin, eyes,	dizz, drow, head, nausea; eye,	Mixture aliphatic hydrocarbons;

(naptha, aliphatic petroleum naptha, benzine, petroleum ether)		-86	40	resp, CNS	nose, throat irr; dry, cracked skin; chemical pneumonia (asp)	may contain n-hexane if boil pt. <156 F
VM&P naptha (benzine)	300	>22	2 to 20	skin, eyes, resp, CNS	dizz, drow, head, nausea; eye, nose, throat irr; dry, cracked skin; chemical pneumonia (asp)	One of the least toxic, but flammable
gasoline	300	-45	-	skin, eyes, resp, CNS	dizz, drow, head, nausea; eye, nose, throat irr; dry, cracked skin; chemical pneumonia (asp)	Do not use; may contain benzene and/or lead
mineral spirits (Stoddard solvent, paint thinner)	100	>100	appx. 4 (77 F)	skin, eyes, resp, CNS	dizz, drow, head, nausea; eye, nose, throat irr; dry, cracked skin; chemical pneumonia (asp)	Odorless paint thinner, turpenoid or mineral spirits with reduced aromatics preferred. Combustible
kerosene (Fuel oil #1)	none	110 to 162	-	skin, eyes, resp, CNS	dizz, drow, head, nausea; eye, nose, throat irr; dry, cracked skin; chemical pneumonia (asp)	No TLV or PEL established. Use TLV for mineral spirits
n-hexane	50	-7	150 (77 F)	skin, eyes, resp, PNS, CNS	head; nausea; numbness of extremities; musc weakness; eye, nose irr; chemical pneumonia (asp)	Do not use; extremely flammable; other hexane isomers similar to heptane
AROMATIC HYDROCARBONS						**Try to avoid aromatic hydrocarbons**
toluene (toluol)	100	40	20 (65 F)	CNS, liver, kidneys, skin, repro, eyes	fatigue, weak; confusion, euphoria, head, dizz; dilated pupils; insomnia; derm; chemical pneum (asp)	Absorbed through skin
xylene (xylol)	100	81	9	CNS, eyes, GI, blood, liver, kidneys, skin, repro	dizz, drow, incoherence, staggering gait; eye, nose, throat irr; anorexia, nausea, abdom pain; derm; chemical pneum (asp)	Absorbed through skin
coal-tar naptha	100	100	<5	resp, skin, eyes	lightheadedness, drow; skin, eye, nose irr; derm; chemical pneum (asp)	Do not use; mixture of aromatics; can contain benzene; Absorbed through skin
styrene (vinyl benzene)	50	88	5	CNS, resp, eyes, skin, PNS	eye, nose irr; drow, weakness, unsteady gait; narcosis; derm; numbness; chemical pneum (asp)	Absorbed through skin
benzene (benzol)	1	12	75	blood, CNS, skin, bone marrow, eyes, resp	eye, nose, resp irr; dizz, head, nausea; chemical pneum (asp); bone marrow depression, cancer	Do not use; causes leukemia; Absorbed through skin; extremely flammable
CHLORINATED HYDROCARBONS						**Try to avoid chlorinated hydrocarbons. NIOSH ** May produce phosgene gas and other toxics when heated or exposed to UV.**
methyl chloroform (1,1,1-trichloroethane, chlorothene)	350	none	100	CNS, skin, eyes, heart	head, lassitude, CNS, poor, equilibrium; eye irr; derm; heart arrhythmias	One of the least toxic; can be fatal in enclosed spaces or "sniffing"; REL 350 ppm
trichloroethylene (ethylene trichloride, trichloroethene, triclene)	50	90	58	resp, heart, kidneys, liver, CNS skin	head, vertigo; vis dis, tremors, drow, nausea, vom; eye irr; derm; heart arrhythmias, abnormal skin sensations	Do not use; suspect carcinogen; absorbed through skin; REL 25 ppm; NIOSH**
methylene chloride (methylene dichloride, dichloromethane)	50	none	350	CNS, skin, eyes, heart	fatigue, weak, sleepiness; limbs numb, tingle; nausea; flushed face= neck (esp w/alcohol); liver damage; cancer; derm	Do not use; suspect carcinogen; forms carbon monoxide in blood; NIOSH**
perchloroethylene (tetrachloroethylene)	25	none	14	liver, kidneys, eyes, upper resp, CNS	nose, eye irr; CNS depression; liver, kidney damage	Do not use; suspect carcinogen; absorbed through skin; NIOSH**
1,1,2-trichloroethane (beta--trichloroethane,	10	none	19	CNS, eyes, nose, liver,	CNS depression; nose, eye irr; liver, kidney damage	Do not use; suspect carcinogen; absorbed through

vinyl trichloride)				kidneys		skin; NIOSH**
carbon tetrachloride (carbon tet)	2*	none	91	CNS, eyes, lungs, liver, kidneys, skin	CNS depression; nausea, vom; liver, kidney damage; skin irr	Do not use; suspect carcinogen; absorbed through skin; many fatalities with alcohol; NIOSH**
chloroform (methane trichloride, trichloromethane)	2*	none	160	liver, kidneys, heart, eyes, skin	dizz, mental dullness, nausea, disorientation; head, fatigue; anesthetic; skin, eye irr	Do not use; suspect carcinogen; absorbed through skin; NIOSH**
ethylene dichloride (1,2-dichloroethane, ethylene dichloride)	1*	56	64	liver, kidneys, CNS, eyes, skin	CNS depression; nausea, vom; derm; eye irr, corneal opacity	Do not use; suspect carcinogen; absorbed through skin; NIOSH**
1,1,2,2,-tetrachloroethane (acetylene tetrachloride)	1	none	9 (86 F)	liver, kidneys, CNS, blood	nausea, vom, abdom pain; tremor fingers; jaundice, enlarged liver; derm; increased monocytes in blood	Do not use; suspect carcinogen; absorbed through skin; NIOSH**
ESTERS						
ethyl acetate	400	24	746	eyes, skin, resp	eye, nose, throat irr; head, drow; derm	Least toxic ester
isopropyl acetate	250	36	42	eyes, skin, resp	eye, nose, skin irr; derm; head, drow	
methyl acetate	200	14	173	eyes, skin, resp	nose, throat irr; head, drow; optic atrophy	Extremely flammable
sec-amyl acetate	125	89	7	eyes, skin, resp	eye, nose, skin irr; derm; head, drow	
isoamyl acetate (banned)	100	77	4	eyes, skin, resp	eye, nose, throat irr; derm; head, drow	
n-amyl acetate	100	77	5 (77 F)	eyes, skin, resp	eye, nose irr; derm; head, drow	
ETHERS						**Forms explosive peroxides**
ethyl ether (ether, diethyl ether)	400	-49	440	CNS, skin, resp, eyes	dizz, drow, head, nausea, vom; skin, eye, URT irr	Do not use; extremely flammable
tetrahydrofuran (THF)	200	6	132	CNS, skin, resp, eyes	eye, URT irr; nausea, dizz, head	Do not use; extremely flammable
dioxane	25	55	29	liver, eyes, kidneys, skin	drow, head, nausea, vom; eye, nose, throat irr; liver damage; kidney failure; derm	Do not use; suspect carcinogen; REL 1 ppm C; NIOSH**
GLYCOLS						
propylene glycol (1,2-propanediol)	-	210	0.07	skin. eyes	slight skin, eye irr; practically non-toxic by ing	Least toxic glycol
triethylene glycol (triglycol)	-	350	<0.01	skin. eyes	slight skin, eye irr; slightly toxic by ing	
ethylene glycol (glycol, 1,2-ethanediol)	50 C	241	0.06	liver, eyes kidneys, resp, skin	eye, nose, throat irr; head, nausea, vom, kidney, liver damage; skin sensitizer	Absorbed through skin; lethal oral dose adult 100 ml
diethylene glycol (carbitol)	50 AIHA	255	0.01	liver, eyes kidneys, resp, skin	nausea, dizz, kidney & liver damage (ing); mild skin, eye, resp irr	Absorbed through skin; lethal oral dose adult 70 ml
GLYCOL ETHERS and their acetates						**Try to avoid ethers**
2-butoxyethanol (butyl cellosolve, ethylene glycol monobutyl ether)	25	143	0.8	liver, eyes, kidneys, lymphoid system, skin, blood, resp	eye, nose, throat irr; blood, liver, kidney damage; head, dizz, nausea	skin absorption more serious than inhalation; not shown to have adverse reproductive effects like others
2-ethoxyethanol (cellosolve, ethylene glycol monoethyl ether)	5	110	4	lungs, eyes, blood, kidneys, liver, repro	eye, resp irr; anemia (bone marrow); liver, kidney damage; lowered sperm count, miscarriages in humans	Do not use; absorbed through skin; serious reproductive effects in humans and animals; NIOSH**
2-methoxyethanol (methyl cellosolve, ethylene glycol monomethyl ether)	5	102	6	CNS, blood, skin, eyes, kidneys, repro	head, drow, weakness; anemia, bone marrow damage; ataxia, tremors, lethargy; eye irr	Do not use; absorption more serious than inhalation; serious reproductive effects in humans

						and animals; NIOSH**
2-ethoxyethanol acetate (cellosolve acetate, ethylene glycol monoethyl ether acetate)	5	124	2	resp, eyes, GI, repro	eye, nose irr; head, nausea, vom; liver and kidney damage	absorbed through skin; similar to but more irritating than 2-ethoxyethanol; NIOSH***
2-methoxyethanol acetate (methyl cellosolve acetate, ethylene glycol monomethyl ether acetate)	5	120	2	kidneys, brain, CNS, PNS	kidney damage; brain damage; eye irr	absorbed through skin; similar to but more irritating than 2-methoxyethanol; NIOSH***
KETONES						
acetone (dimethyl ketone)	750	0	180	resp, skin CNS	eye, nose, throat irr; derm; head, dizz	Least toxic ketone; extremely flammable; REL 250 ppm
methyl ethyl ketone (MEK, 2-butanone)	200	16	71	CNS, resp	eye, nose, throat irr; head, dizz, vom	Extremely flammable; synergistic with hexane and methyl butyl ketone
methyl isobutyl ketone (MIBK, hexone)	50	64	16	resp, eyes, skin CNS	eye, nose, throat irr; derm; head, dizz, nausea	Very objectionable odor; absorbed through the skin
methyl isoamyl ketone (MIAK)	50	96		resp, eyes, skin CNS, liver, kidneys	eye, nose, throat irr; derm; head, dizz, nausea	
cyclohexanone (pimelic ketone)	25	146	5 (77 F)	resp, eyes, skin CNS, liver, kidneys	eye, nose, throat irr; derm; head, dizz, nausea	absorbed through the skin
methyl butyl ketone (MBK, 2-hexanone)	5	77	4 (77 F)	CNS, PNS, skin, resp	eye, nose irr; numbness of extremities, musc weakness; derm; head, dizz, drow	Do not use; absorbed through the skin; REL 1 ppm
isophorone	4*	184	0.4 (77 F)	resp, skin, CNS	eye, nose, throat irr; derm; fatigue, head, dizz, nausea	Do not use; severe depression
OTHERS						
tetrachlorotrifluorethane (Freon 113)	1000	none	284	CNS, heart, resp	cardiac arrhythmias	Emits phosgene gas when heated; other freons act similarly
turpentine (gum spirits)	100	95	5 (77 F)	skin, eyes, kidneys, resp	skin, eye, nose, throat irr; head, vertigo, dizz; sensitizer	Absorbed through skin; replace with turpenoid or odorless mineral spirits
morpholine	20	98	6	eyes, resp sys, skin	visual disturbances; eye, nose, throat irr; cough; liver, kidney damage	Absorbed through skin
dimethylformadine (DMF)	10	136	4 (77 F)	heart, kidneys, liver, skin, testes	head, dizz, nausea, vom; liver damage; high blood press; facial blush; derm; testicular cancer; kidney, heart damage (animals)	Avoid if possible; absorbed through skin; suspect carcinogen; NIOSH**
carbon sulfide (carbon bisulfide)	4*	-22	297	CNS, PNS, heart, eyes, kidneys, liver, skin, repro	head, dizz; poor sleep, nervousness, psychosis; liver, kidney, PNS and CNS damage; skin, eye burns and irr; heart disease	Do not use; absorbed through skin; highly toxic; extremely flammable

From: Art Hazards Newsletter

❑ Estimating Silver Removal From Photographic Film

How much silver is generated when a single roll of B&W film is developed?

Silver content is often dependent on the manufacturer and type of film being used, so it is suggested that you contact the film manufacturer directly for detailed information. Since there are several different manufacturers and types of film, potential silver recovery is typically not based on rolls of film, but rather volume of spent fixer and sampling data. Yet, using the following Kodak information you can estimate the amount of silver being placed into a fixer solution.

According to Kodak and the EPA, the following are typical silver contents for film (from EPA Guides to Pollution Prevention, doc. EPA/625/7-91/012):

Film Type	**Silver Content**	
Black & White Film	**Troy oz/sq. ft**	**milligrams/sq. ft**
Photofinishing	0.0105	326.5867
Low Speed - ISO 32	0.0073	227.0555
Med. Speed - ISO 125	0.0104	323.4764
High Speed - ISO 320-400	0.0156	485.2146
Ultr-fast - ISO 1250	0.0264	821.1324
B&W Prints	0.0024	74.6484

For a roll of color film, the following can be used (silver removal is 100% for color film).

Film Type	**Silver Content**	
Color Film	**Troy oz/sq. ft**	**milligrams/sq. ft**
Negative Process C-41		
Kodacolor II	0.0169	525.6492
Vericolor II	0.0208	646.9528
Kodacolor 400	0.0278	864.6773
Kodacolor VR 200, 400, 1000	0.0268	833.5738
Kodacolor VR 100	0.0187	581.6355
Vericolor III	0.0244	758.9254
Vericolor Slide/Print	0.0088	273.7108
Reversal Process E-6		
Low Speed	0.0122	379.4627
Med. Speed	0.0121	376.3524
High Speed	0.0149	463.4422
Duplicating	0.0121	376.3524
Duratrans Display 4022	0.0020	62.207

Unlike color film, attempting to estimate silver discharge per roll of B&W film is difficult. Since some of the silver remains on the film after processing you may have several rolls of film where you wash off 75% of the silver while other rolls you may wash off only 10% of the silver. It is assumed that an average removal of 60% occurs from processing B&W film (PMA Code).

Converting the Estimated Silver Removal Information into Usable Numbers

Getting to milligrams per liter (or parts per million, ppm):

If you use one liter of solution and strip one milligram of silver from film, you have 1 milligram per liter of silver in a solution (similar to ppm). You can estimate what the silver content is by determining the bath volume in liters and estimating the amount of silver being stripped from the film you are processing.

Converting Troy ounces to grams use:								
Troy ounces	x	31.1035 grams/troy ounce	=	grams	x	1000 milligrams/gram	=	milligrams
Example:								
0.1 Toz	x	31.1035 g/Toz	=	3.11035 g	x	1000 mg/g	=	3,110.35mg

assuming that for black and white film you are stripping 0.0024 Troy ounces per square foot, you will be stripping:

0.0024 Troy ounces x 31.1035 grams/Troy ounce = 0.0746484 grams x 1000 =
= 74.6484 milligrams per square foot of film

If you know the volume of your bath, you can estimate the concentration of the bath.
If it's a ten gallon bath:

gallons x 3.7853 liters/gallon = liters, therefore:

10 gallons x 3.7853 liters/gallon = 37.853 liters
74.6484 milligrams divided by 37.853 liters = 1.97 milligrams per liter (ppm)
(roughly 2 milligrams per liter per square foot of B&W film)

Standard Film Roll Area in square feet:

Film Size		Area in square feet
110	12 exposure roll	0.078
110	20 exposure roll	0.113
110	24 exposure roll	0.131
126	12 exposure roll	0.177
126	20 exposure roll	0.272
126	24 exposure roll	0.319
120	roll	0.538
220	roll	1.090

Film Size		Area in square feet
620	roll	0.530
127	roll	0.305
135	12 exposure roll	0.268
135	20 exposure roll	0.382
135	24 exposure roll	0.440
135	36 exposure roll	0.619
828	roll	0.163

Example:

If you process 1 roll of 135 12 exposure film (at 0.268 sq. ft.) of B&W High Speed - ISO 320-400 (at 0.0156 Toz/square ft):

0.268 ft^2/roll x 0.0156 Toz/sq.ft. = 0.0041808 Troy ounces/roll

0.0041808 Toz/roll x 31.1035 grams/Toz = 0.130 grams silver/roll

0.130 grams silver/roll x 1000 milligrams/gram = 130.04 milligrams silver/roll

Assuming a ten gallon bath = 37.853 liters:

130.04 milligrams divided by 37.853 liters = 3.44 mg/L (or ppm)

Since recovery may yield $1.00 to $3.00 (say, an average of $2.00 per Toz, depending on the company) this generates about $0.01 per roll (0.0041808 x $2.00).

Calculating Silver Concentration in a Fixer Solution Worksheet

EXAMPLE: Film - B&W 135, 12 exposure, ISO 320-400

		A	B	
Explanation	**Calculation**		**Total**	Row
Silver content per square foot of film		0.0156		1
Square feet of film per roll		0.268		2
Calc. Troy ounces silver per roll of film	A1 x A2 = B3		0.004	3
Calc. grams of silver per roll of film	B3 x A4 = B4	**31.1035**	0.13	4
Calc. milligrams of silver per roll of film	B4 x A5 = B5	**1,000**	130	5
Estimated percentage removal (for color, removal is 100% or 1). For B&W typical estimate is 60% removal calculated using 0.60	B5 x A6 = B6	0.60	78	6
Calc. Bath Size in Liters				
Bath Size in Gallons		10		7
Calc. Liters	A7 x A8 = B8	**3.7853**	37.85	8
Calc. milligrams per liter of silver				
Milligrams of silver per roll of film	B6 = A9	78		9
Bath size in liters	B8 = A10	37.85		10
Calc. milligrams per liter of silver in a fixer bath	A9÷A10 = B11		2.0608	11

Calculating Silver Concentration in a Fixer Solution Worksheet

Insert Your Information		A	B	
Explanation	**Calculation**		**Total**	Row
Silver content per square foot of film				1
Square feet of film per roll				2
Calc. Troy ounces silver per roll of film	A1 x A2 = B3			3
Calc. grams of silver per roll of film	B3 x A4 = B4	**31.1035**		4
Calc. milligrams of silver per roll of film	B4 x A5 = B5	**1,000**		5
Estimated percentage removal (for color, removal is 100% or 1). For B&W typical estimate is 60% removal calculated using 0.60				6
Calc. Bath Size in Liters				
Bath Size in Gallons				7
Calc. Liters	A7 x A8 = B8	**3.7853**		8
Calc. milligrams per liter of silver				
Milligrams of silver per roll of film	B6 = A9			9
Bath size in liters	B8 = A10			10
Calc. milligrams per liter of silver in a fixer bath	A9÷A10 = B11			11

Section 3:
Photoprocessing Checklists

Silver recovery is the predominant method available to photoprocessors to reduce the amount of silver being discharged from their business. This section begins with the photoprocessing checklists which refer to additional information. The checklists are designed to assist you in detailing your process(es) and will direct you to information concerning your process types and waste volumes.

If you are a photoprocessor, it is recommended that:

1. You begin by completing the checklist.
2. From the checklist you will begin to see the options developed for, and the concerns that exist about, your process type.
3. After completing the checklist you can then reference additional material for more detailed information concerning silver recovery, etc.

The following checklists and information sets out to:

1. Explain the options that you, as a photoprocessor, have available to reduce your silver discharge.
2. Meet or exceed and maintain discharge requirements, thus reducing your interaction with government regulators.
3. Reduce or eliminate the need to dispose of silver bearing wastes. Doing so reduces or eliminates the liability your business faces by handling your wastes as hazardous materials.
4. Help you recover silver which can then be sold and the money returned to your business.

Checklist	Comments	Refer to
1. Is your process primarily black & white, color, or a combination? **B&W** **Color** **Combination (appx. 50% B&W and 50% color)**	Color processing will generate the greatest amount of recoverable silver. All silver used for color photos is removed when developed while only a percentage is removed in B&W processing.	pg. 2:1
2. Do you replace fixer and developer at the same time? **YES** **NO**	Fixers can outlive developer 2 to 6 times. Use of a fixer or silver test kit can reduce chemistry costs. Kits can be test strips or drops. Air and heat are the main contaminants of developers. Use floating lids and monitor developer temperature to extend developer life.	 pg. 4.17
3. Do you know how much fixer you use? **YES** **NO**	Knowing how much fixer you use will help you determine whether you should consider recovery equipment or off-site recovery. There are specific volumes where recovery equipment is economically viable.	pg. 4:1 to 4:12
4. Do you know how much film (B&W and color) you process? **YES** **NO** **5. Do you mix regular fixers with bleach-fix?** **YES** **NO**	Knowing how much film you process can help in estimating how much silver you could be recovering. Doing so can reduce silver recovery efficiency. If possible you may want to segregate and treat the different fixers separately. Also check with the silver recovery equipment supplier about mixing the fixers.	pg. 2:9 to 2:12

A. Automated Processing:	Comments	Refer to
1. Is your automated processor a: **single rinse developer?** **A double rinse developer?** **A unit with three or more rinse tanks?** **A washless system?**	Processors that have three rinse tanks will discharge lower concentrations of silver from the final rinse tank. Rinse water from the 1st and 2nd rinse tanks can often be processed through silver recovery equipment.	pg. 4:15 see also Appendix D, Case Studies
2. Is your automated processor plumbed to a recovery system? **YES** **NO**	Silver rich solutions from processors should be plumbed to silver recovery equipment or captured. Fixer should not be combined with developer, doing so will impair silver recovery.	See Appendix D. Case Studies
5. Do you use continuous silver recovery?	Using a continuous system can reduce your fixer replenishment by up to 75%. This type of system also recovers much of the silver and reduces your process discharge.	pg. 4:10
6. When you process film, Do you attempt to reduce your water use? **YES** **NO**	Using rinse tanks and not running the water continuously will greatly reduce the amount of water you use. This includes dilution. Dilution is not a method of waste reduction. With dilution you are simply reducing the concentration of the waste material, not reducing or eliminating the waste you generate. Are your washes on automatic timers? If so are the timers properly set and are solenoid valves and switches working properly.	pg. 4:15 to 4:21 and 2:2 Remember: **Dilution is not the Solution to Pollution**

B. Tray developing:	Comments	Refer to
1. Do you capture spent fix? **YES** **NO**	Capturing spent fix from tray developing processes is as important as it is in automated systems. By not capturing spent fix you are discharging large quantities of recoverable silver that could be captured and recovered. If you already have a silver recovery system or procedure you can include this fixer for silver recovery.	
2. When you process film, Do you attempt to reduce your water use? **YES** **NO**	Using rinse tanks and not running the water continuously will greatly reduce the amount of water you use. You can also use a kitchen timer to remind yourself when the washing step is complete.	pg. 4:15 to 4:21 and 2:2 Remember: **Dilution is not the Solution to Pollution**

Appendix A
Joint Task Force Members

The City of Albuquerque would like to thank the New Mexico Silver Users Association and the following for their participation and assistance in developing this Code of Practice.

Ron Taylor	Koogle & Pouls Engineering
Karen Doty	Brooks Photo, Inc.
Gail Miller	Carl=s Darkroom
David Nycz	Academy Corporation
Pat Berrett	Pat Berrett, Photographer

Appendix B
City, State & Federal Environmental Resources

Department	Phone
City - Albuquerque:	
Pollution Prevention Program - Non-Regulatory	873-7004
Hazardous Waste Program - Non-Regulatory	768-2600
Storm Water/Hydrology - Non-Regulatory	768-2650
Air Quality Assistance Program - Non-Regulatory	768-1964
Solid Waste Management	761-8180/8182
Fire Marshal's Office (Hazmat information)	888-8124
Hazmat Emergency Response:	911
(Describe spill and material to dispatcher)	
LEPC - Local Emergency Planning Committee	764-6353/6322
P.O. Box 2086, Albuquerque, NM 87103	
Fire Department Dispatch (for LEPC after hours and on weekends)	243-6601
Southside Water Reclamation Plant	
Pretreatment Unit - Weekdays	873-7004
Emergency - Weekends	873-6217
Silver Users Trade Association	
Ron Taylor - President	294-5053
For info on memberships, etc. write to: New Mexico Silver Users Association, PO Box 25801, Albuquerque, NM 87125	
Poison Control	843-2551
State - New Mexico:	
OSHA - On-Site Consultation - Non-Regulatory	1-800-222-6742
Technical Services Section	1-505-827-4231/4232
1190 St. Francis Dr., P.O. Box 26110, Santa Fe, NM 87502-6110	
Local Albuquerque Office (non-consultation)	766-3411
Environment Department Region 1	1-505-841-9450
Emergency Response Commission	1-505-827-9300
Hazardous Waste Management Agency	1-505-827-4308
Hazardous Waste Assistance (6 month amnesty)	505-827-1558
New Mexico Industry Network Corporation (NM-INC) - Albuquerque	843-4250
Small Business Development Center (STARS system) - Albuquerque	224-4246
Federal - Regional & National:	
National Association Photo Manufacturers (PMA)	1-517-788-8100 or 1-800-762-9287
EPA Region 6 - Air & Hazardous Materials Division	1-214-767-2600
1201 Elm St.	
Dallas, TX 75270	
RCRA Superfund Hotline	1-800-424-9346
Nation Response Center - Emergency number	1-800-424-8802 or 1-202-267-2675
Non-Emergency calls	1-202-887-1255
CHEMTREC - Non-emergency number	1-800-262-8200
EPA Small Business Ombudsman	1-800-368-5888
National Institute for Occupational Safety and Health (NIOSH)	1-800-35-NIOSH
EPCRA Hotline (TRI information)	1-800-535-0202
EPA Office of Water (EPA OW) - P2 Coordinator	1-202-260-6790
EPA Office of Solid Waste - Waste Minimization	1-703-308-8439/8402
NTIS - Public Searches	1-703-487-4642
NTIS - Sales	1-703-487-4650

EPIC

Environmental Programs Integration Committee
Members & Contact Numbers

- **Pollution Prevention Program**.....**(505) 873-7059/7004 (E-Mail: dgates@cabq.gov)**

  Dan Gates - Providing pollution prevention information, waste reduction assessments, and free wastewater analysis to businesses discharging into the City of Albuquerque's sewer system or area septic tanks. The free non-regulatory Program offers economical, appropriate and real world pollution prevention/source reduction information and examples. The Program Recognizes local business efforts by awarding the 5PPM Silver Certificate and the Pollution Prevention Award. Assistance and information is provided county and state wide.

- **Storm Water/Hydrology** .....**(505) 768-2650**

  Valerie Hanson - EPA NPDES storm water discharge permit applications for storm water runoff control. Includes regulated industries and construction activity over 5 acres. Technical assistance available to verify whether your industry is regulated, to evaluate facility drainage and help prepare EPA mandated Storm Water Pollution Prevention Plan (SWPPP). **FREE** Industrial and Construction Guidance Manuals and educational materials for teachers, youth or adult groups, neighborhood associations, and so forth.

- **Air Quality Assistance Program.....(505) 768-1964**

  John Liberatore - FREE and NON-REGULATORY industry assistance for air quality. Provides technical assistance and site assessments to all industry on regulatory concerns, air quality requirements, and site requirements. TTY at (505)768-2482.

- **Small Quantity Generator Technical Assistance Program (SQGTA)..(505) 768-2636**

  Therese Martinez-Loner - The SQGTA program provides on-site assistance, educational training, and written guidance for proper hazardous material and waste management. Services are FREE, NON-REGULATORY and CONFIDENTIAL. The program's mission is to provide an educational resource for Albuquerque's business community, enabling voluntary compliance with local, state and federal hazardous material and waste regulations. The goal is pollution prevention and a sustainable business community.

- **Recycling & Solid Waste Management.....(505) 761-8100**

  Jenny V. Chavez - Educational services and information on waste disposal, recycling outlets, and the City's municipal solid waste landfill. To set up an account, dumpster or bin, waste and recycling pick-up, call (505) 761-8100.

- **Sludge Quality Management .....(505) 873-6255**

  Steve Glass - Information on City sludge quality and Rio Grande composted materials. For composted material availability call: **Rowland Nurseries**, or **Western Organic** at (505)877-8670.

The City of Albuquerque Small Business Services Guide, provided through EPIC's efforts, is available by contacting Therese Martinez-Loner.

EPIC is staffed by several City employees working together to address all aspects of environmental protection including: air, water and land resources. The programs are geared toward pro-active pollution prevention through free, non-regulatory business assistance. EPIC grew out of a common need to work cooperatively in providing quality technical assistance.

Appendix C
Equipment Suppliers/Silver Recyclers

The following lists are not complete lists of all companies available. The City of Albuquerque does not endorse any of the listed companies or the services they provide. For additional information on pollution prevention contact Dan Gates or Brynda Gutierrez at (505) 873-7058 or 873-7059.

Academy Corporation
6905 Washington NE
Albuquerque, NM 87109 (800)545-6685

American Diversified
(Division of Safety-Kleen)
1004 E Orangefair Lane
Anaheim, CA 92801 (714)738-4941

Commodity Refining
116 East Prospect Ave.
Burbank, CA, 91502 (818)843-2811

Eastern Smelting
37-39 Bubier Street
Lynn, MA 01901 (617)599-9000

Environment-CPC
1680 Carmen Dr
Elk Grove, IL 60007 (708)981-0310

Envirosolve Waste Services Inc.
5338 Williams SE
Albuquerque, NM 87105 (505)873-0964

Hallmark Refining
1743 Cederdale Rd..
Mount Vernon, WA 98273 (800)255-1895

Handy & Harmon
300 Rye Street
South Windsor, CT 06074-1220
(203)289-4327/fax#(203)289-6494

Profit Recovery Systems
2364 Leicester Rd..
Leicester, NY 14481 (800)477-1417

S.D.L. Inc.
237 Lafayette Ave.
Hawthorne, NJ 07506 (800)468-2646

Safety-Kleen Corp.
2720 Girard NE
Albuquerque, NM 87107 (505)884-2277

Springfield Silver
110815 State Rt.. 161
P.O. Box 89
Mechanicsburg, OH 43044 (513)834-2293

Safetyloid Reclamation Co.
125 Glenn Street
Lawrence, MA 01843 (800)942-5337

Southwest Radiographics
4610 - A McLeod NE
Albuquerque, NM 87109 (505)883-9605

Silver Recovery Services/Equipment for Small Volumes

Academy Corporation
6905 Washington NE
Albuquerque, NM 87109 (800)545-6685

Berg Color Tone, Inc.
72 Ward Rd.
Lancaster, NY 14086 (716)681-2696

FR Chemicals
500 Halstead Park Ave.
Mamaronick, NY 10543

Litho-Supply, Inc.
1430 Girard Bvd. NE
Albuquerque, NM 87106 (505)265-3556

Commodity Refining & Environment
116 East Prospect Ave.
Burbank, CA 91502 (818)843-2811

Rotex Silver Recovery Co.
2000 Larch
Springfield, OH 45505 (513)322-0198

US Environmental Recovery Company
825 Schoenharr Dr. Box 43
West Ben, WI 53095 (414)334-3000

Companies that Buy Scrap Film for Silver Recovery

Academy Corporation
6905 Washington NE
Albuquerque, NM 87109 (800)545-6685

Century
1448 East Cliff Rd.
Burnsville, MN 55337 (612)890-2177

Chicagoland Processing Co.
501 Algonquin Rd.
Mt. Prospect, IL 60056-5705 (708)981-0315

Colorado Recovery, Inc.
58 Pyles Lane
Wilmington, DE 19801 (302)998-8044

DMS Refining
45 East Knoxville
Danridge, TN 37725 (615)397-3963

DSS International
6403 Bayway Dr.
Baytown, TX 77520 (713)424-2213

Appendix D
Case Studies

❑ Background Information:

Company: Brooks Photo, Inc.
Operation: Commercial Photo Processing
Date of visit: June 24, 1993

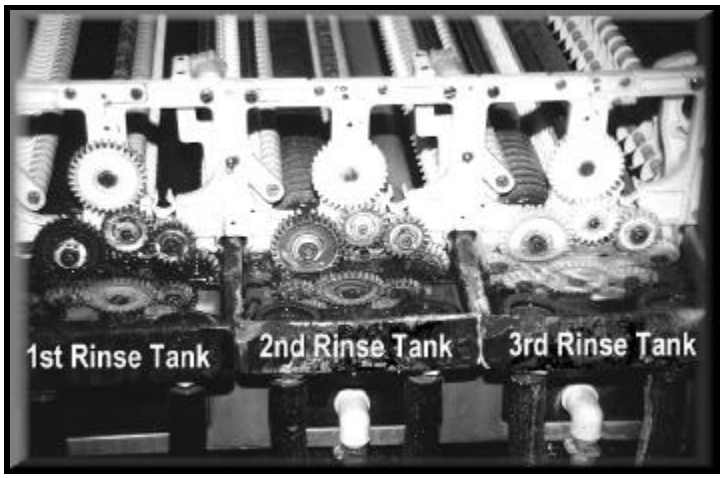
❑ Wastewater Stream Delineation:

1. Fix and bleach fix which flows from five developing machines operated at Brooks. These machines are listed below:

    1. slide processor (E-6)
    2. black & white film processor
    3. black & white paper processor
    4. color negative processor (C-41)
    5. color paper processor (RA-4)

The combined wastestream contains used fix/bleach-fix and any silver removed from the developed film and paper.

2. Processor using a replenished wash system in which the overflow and drain from the first wash tank is routed and plumbed to the silver recovery system.



❑ Waste Minimization Practices

1. Brooks Photo utilizes a silver recovery system to remove the silver from waste stream number 1. The system has two components - an electrolytic recovery unit and two silver recovery cartridges. Fix and bleach fix from all five machines flows into the electrolytic unit and then through two Silver Sur 1000 Cartridges. The cost for this system was approximately $4,000.00

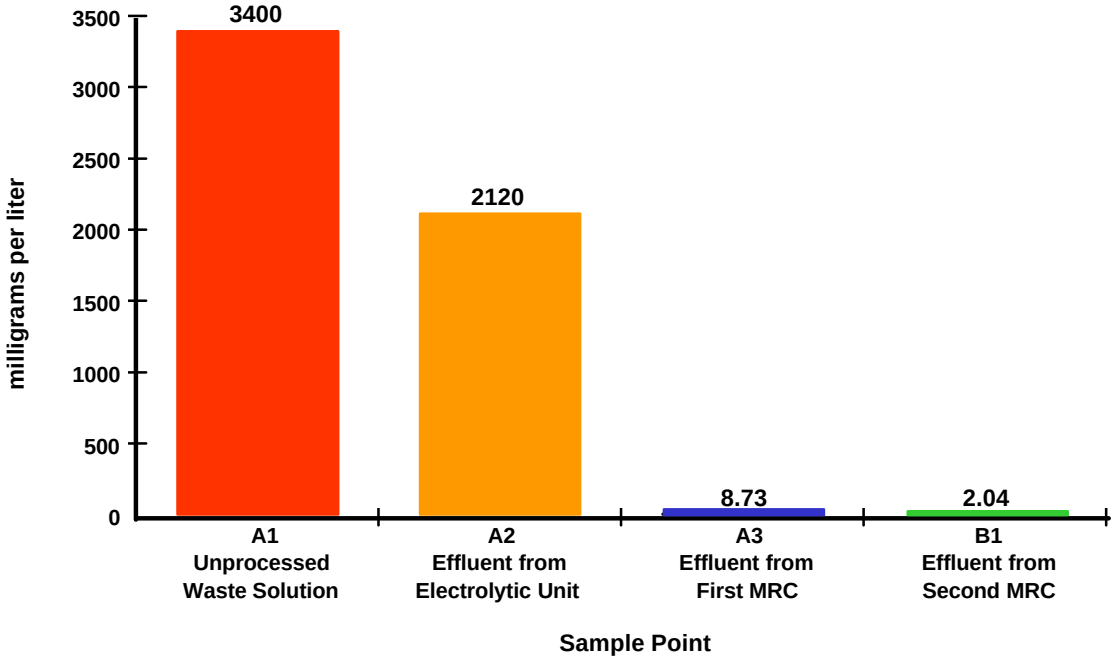
2. Silver is recovered from the color paper processor first wash tank water. This machine has three rinse tanks instead of only one, resulting in a greatly reduced outflow of silver bearing waste. Due to silver concentration in some of the rinse waters (see Picture D1 - note that equipment changes from dark to light as silver concentration is reduced from the first rinse tank to the third rinse tank) rinse water from the first two tanks is routed through the silver recovery equipment. All other rinse water is discharged to the sewer. In the current RA-4 configuration there is only two wash tanks.

❑ Effluent Testing/Results

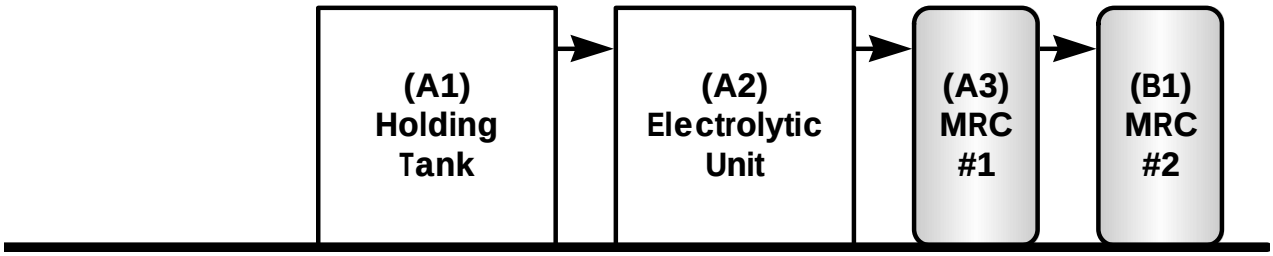
Wastewater stream number 1 was sampled on June 25, 1993. At the point of discharge to the sewer the silver concentration was below 2 ppm.

Sample collection began at 9:40 am, June 25, 1993. Four 250 ml samples were collected at the primary holding/pumping station (A1), the secondary reservoir of the electrolytic unit (A2), the effluent from the primary metallic replacement cartridge (A3), and from the tailing cartridge prior to sewer discharge (B1). Samples were also checked for field pH.

Estimated waste fix processed by the silver recovery equipment averages approximately 35 gallons per week (140 gal/month).



When the electrolytic recovery unit was removed for sample collection silver was present on the recovery plates in silver plumes. The recovered silver was recognizable as fine (pure) silver.



Silver Conc. (mg/L)	**3400.00**	**2120.00**	**8.73**	**2.04**
Silver Reduction (%)		**37.6**	**99.6**	**76.6**
pH	**7.3**	**7.6**	**7.8**	**7.9**

Final discharge meets and exceeds the 5 parts per million discharge requirement of the 5PPM Silver Program. From this data it can be seen that the metal replacement cartridges are effective in reducing the silver content in waste photographic fixer solutions and that the 5ppm level can be accomplished at the discharge location of the equipment.

❑ 5 ppm Silver Program

Brooks Photo is a certified member of the 5 ppm Silver Program.

❑ Background Information:

Company: Carl's Darkroom
Operation: Film (negative and slide film) processing (C-41 & E-6)
Date of visit: June 25, 1993

❑ Wastewater Stream Delineation

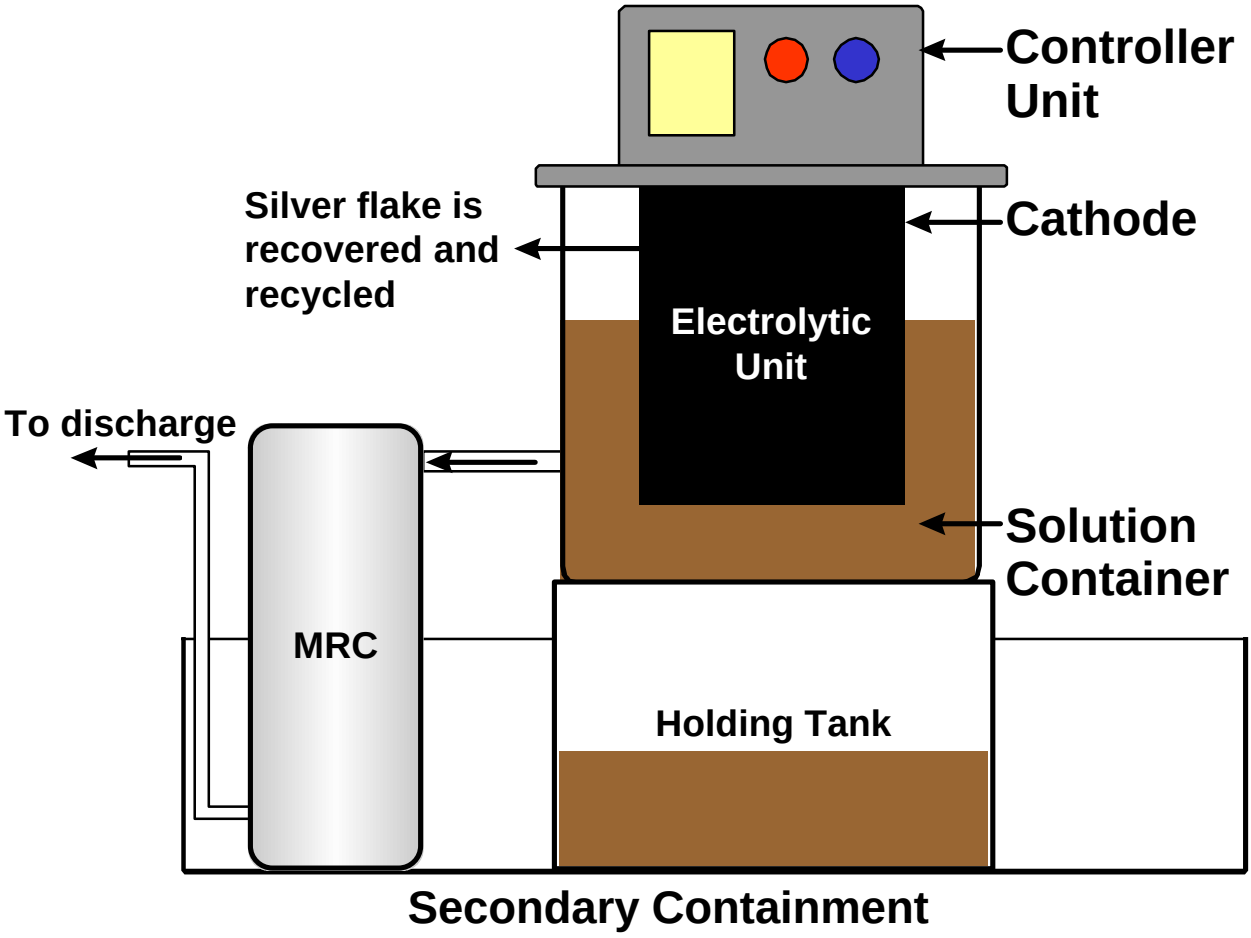
The only wastewater stream at Carl's Darkroom is the silver containing fix discharged from the color film and color slide processing machines.

❑ Waste Minimization Practices

Carl's Darkroom utilizes an electrolytic unit to recover silver from the fix prior to discharge. Fix from both machines is pumped into a small holding tank, from there it is slowly metered into the electrolytic unit. The electrolytic unit's 1988 cost was $2,500.00 and was paid for within one year of operation. Since 1988 more than 1,300 troy ounces (appx. 90 pounds) of silver has been recovered.

❑ Other Potential Waste Minimization Activities

Electrolytic units typically cannot reduce silver concentration below 100 or 200 ppm. The unit at Carl's Darkroom, however, has been tested, in the past, at 3 ppm. For consistency, though, Carl's Darkroom has added one trailing metal replacement cartridge.



❑ Background Information:

Company: Ron's Hour Photo
Operation: Commercial Photoprocessing Lab
Date of visit: July 2, 1993

❑ Wastewater Stream Delineation:

1. Fixer/bleach-fix flowing from the film and paper processing machines. It consists of used fixer and silver ions in solution.

2. Rinse water flowing from the film and paper processing machines. It contains a small quantity of silver.

❑ Waste Minimization Practices

Ron's Hour Photo has installed a Silver Recovery System to remove silver from the fixer prior to discharge. The system consists of two Silver Sur 500 cartridges. As the silver bearing fix is metered slowly through these cartridges the silver ions are removed from the solution. This system cost was approximately $1,500.00

❑ Other Potential Waste Minimization Activities:

1. Fixer solutions:
   a. Backup cartridge unit in case of a malfunction in one of the existing cartridges.

2. Rinse water:

a. Rinse water from the processing machines at Ron's Hour Photo is currently discharged to the sewer. A small quantity of silver, brought into the rinse tanks on the film and paper, is discharged. This silver cannot be economically recovered in cartridge system because of the high flow rate and low silver concentration.

b. Silver in rinse water can be recovered from replenishing or low-flow washes from stabilizers used in 'washless' processors. These machines have multiple wash/rinse tanks instead of one. This results in a reduced rinse water flow and an increased silver concentration in the first wash/rinse tank which could then be processed by silver recovery cartridges.

❑ Effluent Testing/Results

Ron's rotates the cartridges every 4 to 5 months. Testing is performed by the cartridge supplier, Academy Corporation. Maintenance, supplier sampling and MRC rotation insures a discharge of less than 5 ppm.

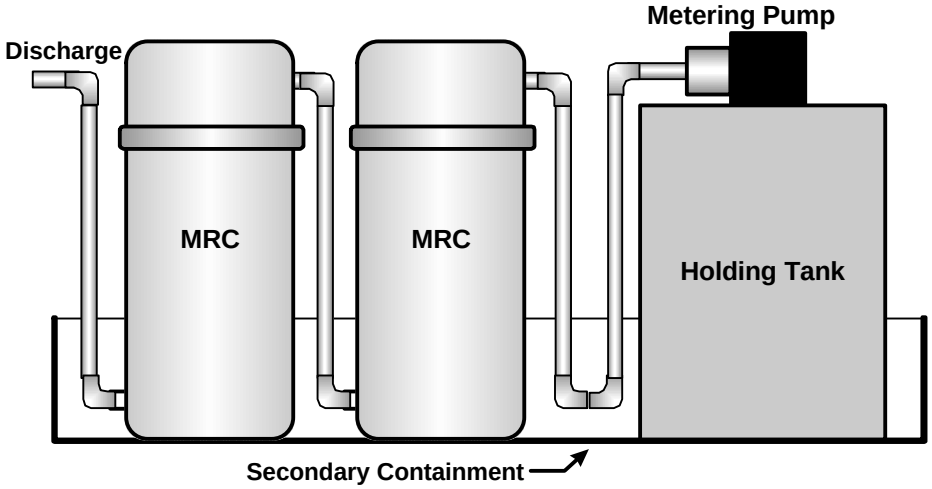


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Photo Marketing Association, Indoor Air Quality in the Photo Lab, PMA International. Available from the City of Albuquerque's Pollution Prevention Program.

Silver Coalition, Code of Management Practice for Silver Dischargers, Silver Coalition/ Association of Metropolitan Sewerage Agencies (AMSA), 1995. Available by contacting Tom Dufficy (NAPM) at: 1-914-698-7603, or Sam Hadeed (AMSA) at: 1-202-833-2672. $10.00